Appendix C3
Access Modification Report
Break in Access Application John James Audubon Parkway

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Acronyms and Abbreviations

AM....Morning
AMR....Access Modification Report
BRT....Bus Rapid Transit
EIS....Environmental Impact Statement
FHWA....Federal Highway Administration
GBNRTC....Greater Buffalo Niagara Regional Transportation Council
GPI....Greenman-Pedersen Inc.
ITE....Institute of Transportation Engineers
LOS....Level of Service
LRT....Light Rail Transit

MD ..... Midday
Metro ..... Niagara Frontier Transit Metro System, Inc
Metro Rail ..... Metro Light Rail Transit System
MOE ..... Measure of Effectiveness
NYSDOT ..... New York State Department of Transportation
PM ..... Evening
Project ..... Buffalo-Amherst-Tonawanda Corridor Transit Expansion Project
ROW ..... Right of Way
UB ..... University at Buffalo

Appendix C. Introduction

The Access Modification Report (AMR) documents the proposed modifications to the roundabout being constructed at John James Audubon Parkway and the Southbound I-990 ramps, as part of the Muir Woods Multifamily Residential Development. The Buffalo-Amherst-Tonawanda Corridor Transit Expansion Project (the Project) would need to modify the planned roundabout to implement a transit service along the Project alignment. The Project's northern station would be in the planned Muir Woods student housing community directly north of I-990. A park and ride facility and storage/light maintenance facility would also be located north of I-990 to support the proposed transit expansion. As part of the Project, the existing lane configuration of John James Audubon Parkway would change. John James Audubon Parkway is currently a four-lane divided facility with two general purpose lanes in each direction. As part of a separate initiative, NYSDOT and the Town of Amherst have discussed closing the northbound lanes and converting the southbound lanes to a two-way roadway. While this initiative is unrelated to the Project, it offers a footprint for the Project alignment that would generally follow the pavement along the current northbound John James Audubon Parkway lanes as a dedicated transit facility.

The following traffic operations analysis was prepared to evaluate the potential traffic impacts resulting from the implementation of the Project on the John James Audubon Parkway and I-990 interchange and adjacent intersections, and to identify mitigation improvements that would minimize project impacts to the surface street network.

The traffic analysis presented in the following analysis utilizes the VISSIM traffic models developed for the Environmental Impact Statement (EIS) study for the transit service. These models were initially developed in 2019 with a base year analysis of 2018 and a horizon year of 2040.

C.1 POLICY REQUIREMENTS

The decision of the Federal Highway Administration (FHWA) to approve a requested change in access to the interstate system is dependent on the proposal satisfying and documenting two requirements (policy points) as outlined in the updated *Policy on Access to the Interstate System* (May 22, 2017). The two required policy points are:

- Operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility or on the local street network based on both the current and planned future traffic projections.
- The proposed access connects to a public road only and will provide for all traffic movements.

The policy changes were made to ensure a focus on safety, operational, and engineering issues. Section C.8 of this AMR documents how the project complies with the two new policy points. Other concerns such as environmental impacts are addressed in Chapter 4, "Environmental Considerations".

C.2 PROJECT DESCRIPTION AND STUDY AREA

The Niagara Frontier Transit Metro System, Inc. (Metro) Metro is proposing to expand high-capacity transit service from the current terminus of its Metro Rail at University Station on the University at Buffalo (UB) South Campus to reach 7 miles north to the towns of Tonawanda and Amherst. The Project considers two build alternatives to achieve this expansion—a Light Rail Transit (LRT) Alternative and a Bus Rapid Transit (BRT) Alternative. As shown in Figure 1, the Project Corridor alignment is proposed along Main Street, Kenmore Avenue, Niagara Falls Boulevard, Maple Road, and Sweet Home Road, through the UB North Campus to John James Audubon Parkway and Interstate 990. As noted in Section Appendix C, the Project would modify the planned roundabout at the John James Audubon Parkway and the Southbound I-990 ramps, as part of the Muir Woods Multifamily Residential Development, to implement a transit service along the Project alignment.

VISSIM[1] traffic simulation computer models were developed to analyze traffic operations and identify the level of service (LOS) at the intersections under existing and future conditions with and without the LRT Build Alternative and the BRT Build Alternative. In 2019, Metro conducted a traffic analysis utilizing VISSIM that focused on 18 signalized and two unsignalized intersections along the Project alignment. In 2021, Metro expanded the VISSIM model to include the evaluation of 25 additional unsignalized intersections along the Project alignment.

The size and scope of the study area for this AMR was discussed with FHWA and New York State Department of Transportation (NYSDOT) and was approved in January 2023. Typically, AMR policy requires adjacent upstream and downstream interchanges be included into the study area to ensure unforeseen impacts are captured. However, given that the Project would have minimal effect on vehicular access or travel patterns, it is unlikely that the Project would have an impact on the adjacent Exits 2 and 4. The inclusion of transit service through the I-990 and John James Audubon Parkway interchange is expected to introduce minor delay increases to the Exit 3 off ramps and result in queues within the available storage preventing ramp backup interactions with I-990 mainline. The intersections studied as part of this analysis are shown in Figure 2 and include the following:

1. John James Audubon Parkway and I-990 Southbound Ramps
2. John James Audubon Parkway and I-990 Northbound Ramps
3. John James Audubon Parkway and Dodge Road

[1] VISSIM is a traffic-flow software package that simulates vehicle interactions and models demand, supply, and behavior.

4. John James Audubon Parkway and Gordon Yaeger Drive
5. John James Audubon Parkway and Sylvan Parkway

Figure 1. Existing Metro Rail and Project Corridor

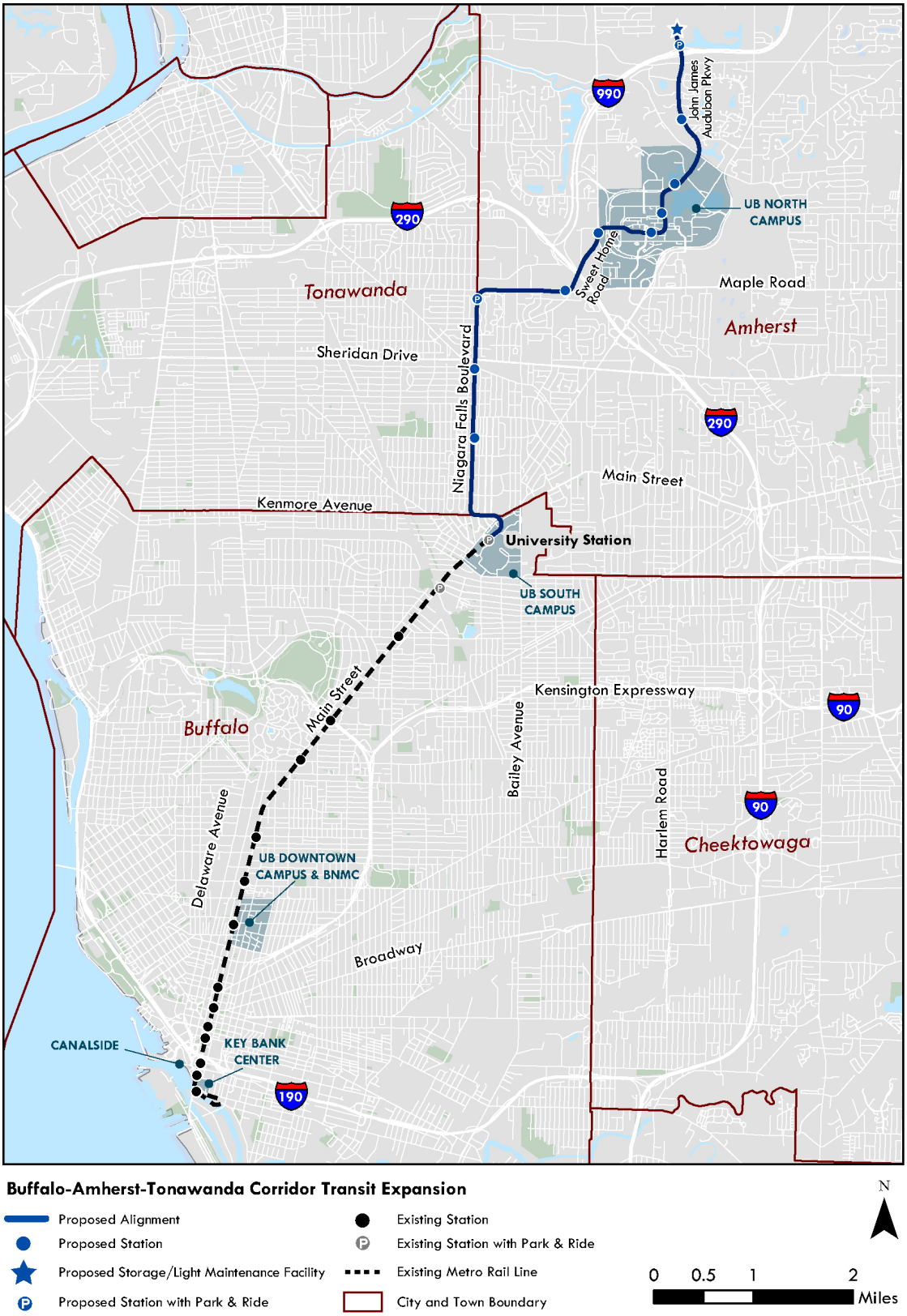
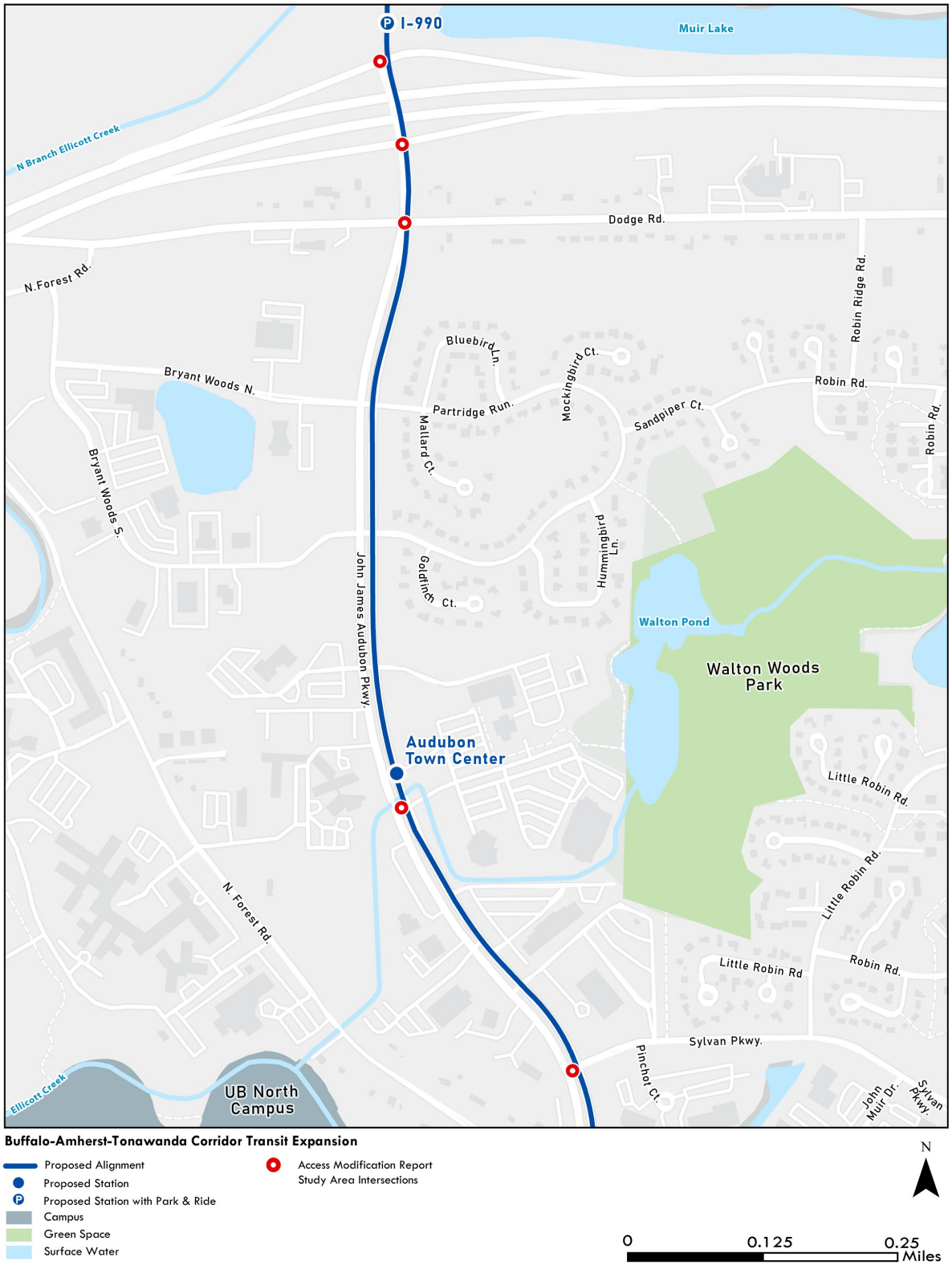


Figure 2: AMR Study Area Map



C.2.1 Roadway Description

A description of the roads and intersections included in the AMR study area is as follows:

John James Audubon Parkway

John James Audubon Parkway runs in a north/south direction and is generally a median divided roadway with two 12-foot travel lanes in each direction and 10-foot shoulders. There are no curbing or sidewalks along the roadway. The posted speed limit is 40 mph.

John James Audubon Parkway and I-990 Southbound Ramps

This T-intersection is controlled by a stop sign for the off-ramp westbound approach with traffic on John James Audubon Parkway having no controls. The north side of this intersection is the location of the planned Muir Woods student housing. The northbound approach on John James Audubon Parkway consists of two travel lanes and a left turn lane to access the I-990 ramp. Both the on and off-ramps consist of a single lane.

John James Audubon Parkway and I-990 Northbound Ramps

This intersection is controlled by a stop sign for the off-ramp with traffic on John James Audubon Parkway having no controls. The two approaches from John James Audubon Parkway consist of two travel lane each direction, and there is an added left turn lane on the southbound approach. Both the on and off ramps consist of a single lane. There is 360 feet of vehicle storage space between this location and the I-990 southbound ramp intersection.

John James Audubon Parkway and Dodge Road

This intersection has two through travel lanes and a left turn lane on both the northbound and southbound approaches, and Dodge Road has single lane approaches in both directions. The intersection is controlled by a traffic signal that includes Protected-Permitted left turn phasing, where left turn vehicles can turn during the green ball interval or during a separate turn arrow interval, in the northbound and southbound directions. Spacing between this location and the I-990 northbound ramp allows for just 325 feet of vehicular storage between the two intersections.

John James Audubon Parkway and Gordon Yaeger Drive

This intersection is controlled by a 2-phase traffic signal. It has two through travel lanes on John James Audubon Parkway in both the northbound and southbound directions and there is an added left turn lane southbound as well. This is a T-intersection with all approaches being median divided. Gordon Yaeger Drive is the access point for the Town of Amherst Courthouse, Police Department, Library and Senior Services Building, but serves no other traffic. It has two lanes (one right turn, one left turn) on its approach to John James Audubon Parkway.

John James Audubon Pkwy and Sylvan Pkwy

This intersection is controlled by a stop sign for the westbound Sylvan Parkway traffic. It is located and John James Audubon Parkway and has no controls. The two approaches from John James Audubon Parkway consist of two travel lane each direction, an added left turn lane on the southbound approach, and a right turn lane on the northbound approach. Sylvan Parkway is a four-lane undivided roadway with a westbound bound approach consisting of a dedicated left and right turn lane.

C.2.2 VISSIM Modeling Methodology

VISSIM 10.0 software was used for the traffic evaluation. VISSIM is a microsimulation model, meaning that traffic movements are explicitly modeled based on geometric parameters, traffic volumes, vehicle types, intersection control, and driver behavior. VISSIM assesses the roadway network in a dynamic fashion, instead of analyzing each intersection or each roadway segment in isolation. Unlike macroscopic analysis, which can be calculated manually, simulation models function only as a computer analysis tool. Average performance statistics, such as vehicle delay, volume served, flow density, and travel time, are measured during the simulation. Furthermore, as a stochastic model, a random number seed guides the assignment of vehicle headways. By varying the random number seed, the model results can also vary with identical inputs. This allows the user to test several iterations with the same input values to determine average performance.

VISSIM provides several measures of effectiveness (MOEs) such as vehicle delay, travel time, queuing, and fuel consumption on a network-wide basis, so that the effects of improvements at a single location may be measured throughout the network. This ability makes VISSIM an ideal tool for testing and comparing alternatives to determine the most effective combination of elements in facilitating mobility for all modes. In addition, the sensitivity of the VISSIM model allows the user to test more subtle changes to the roadway system, such as adjustments in traffic signalization, addition or removal of driveways and access points, changes in bus operations, and others.

The simulation component of VISSIM is a powerful feature, as it provides a graphical, intuitive representation of traffic flow throughout the corridor that is simple to visualize and interpret, making it an ideal tool for presentation to non-technical parties. The following describes the elements involved in coding the conditions in VISSIM, as well as a summary of the calibration/validation of the models and the traffic operations analysis within the study area.

The roadway network was modeled over a scaled aerial photograph provided by Bing Maps. The project team conducted a field review of the entire Project area to inventory signal equipment, pedestrian facilities, and review operations (to assist in identifying deficiencies and calibration of the simulation models).

The traffic signal controllers were modeled in VISSIM to match the signal operations provided by NYSDOT and the Greater Buffalo Niagara Regional Transportation Council (GBNRTC).

C.2.3 Data Collection

Existing turning movement data was compiled from multiple sources and dates to create a balanced existing conditions data set for the AMR analysis.

The following intersections traffic volumes were taken from the *Muir Woods – Site B Proposed Student Housing Community Traffic Impact Study* conducted by Greenman-Pedersen Inc (GPI) in 2019:

1. John James Audubon Parkway and I-990 southbound ramps (2016)
2. John James Audubon Parkway and I-990 northbound ramps (2016)
3. John James Audubon Parkway and Dodge Road (2016)

The following intersection traffic volumes were collected by the project team for the EIS.

4. John James Audubon Parkway and Gordon Yaegar Drive (2018)

A 15-minute short count was collected in the field in 2020 at the location below when the study area for the traffic analysis was expanded north to the I-990 interchange with John James Audubon Parkway. Due to this count occurring during COVID-19 shutdowns, only the relative turning movements were utilized and applied to known approach volumes.

5. John James Audubon Parkway and Sylvan Parkway (2020)

C.2.4 Vehicle Composition and Driver Behaviors

The vehicle composition (cars versus heavy vehicles) was based on the percentages identified in the traffic counts collected by Tri-State Traffic Data. A two percent heavy vehicle composition was determined to be representative for the Project area for all modeled time periods.

The default VISSIM driver behavior parameters were adjusted in the models to represent the types of drivers utilizing the study network more accurately. The average standstill distance was reduced from the default 6.56 feet to 4 feet to increase the capacity of the modeled roadways. This change was determined to match the queueing observed in the field and historical conditions witnessed by the stakeholders. The Wiedemann 74 car following model defaults were utilized which are specifically oriented towards urban surface-street driver behavior parameters, versus the Wiedemann 99 car following model that is specifically oriented towards freeway driver behavior and is the other car following model supported within VISSIM. In addition, minor adjustments from the default VISSIM parameters for lane change distances were necessary to accurately represent the driving behavior exhibited within the study area.

C.2.5 Seed Interval and Model Calibration

A seed interval is the amount of time the model is run in advance of summarizing MOEs. An 1800-second (30-minute) seed interval was used for all time periods. This ensures that the appropriate level of traffic is on the roadway network at the time the MOEs begin recording in the model.

To obtain accurate results from the VISSIM traffic simulation model, the driver behavior parameters may need to be adjusted to calibrate the model to real-world conditions. Driver behavior varies significantly based on location, weather, roadway condition, geometry, and other factors. Model results must be validated by comparing them to real-world measures of operational performance, such as volume served, travel time, queuing, and delay, until a certain level of accuracy is reached. This model validation approach was approved in 2018 during the initial creation of the utilized VISSIM model for the AMR analysis.

For this study, model results were validated based on a combination of volume served and travel time information available through Google Maps from 2018. While volume served is a useful comparison measure for use in model validation, it does not always reflect actual demand. For instance, in real-world conditions, when the demand on a segment of roadway exceeds its capacity, the unserved demand results in queuing, while a volume count on the segment may remain constant or potentially decrease as congestion builds.

The models were considered validated when the volumes served as reported by the model were within the greater of +/-10-percent or +/-20 vehicles of the actual recorded volumes. FHWA recommends a maximum threshold of 15% of model hourly volumes versus observed. The network (end-to-end) travel times were also compared to 2018 Google Maps estimated typical travel time range for the same day and time as the counts. These thresholds were achieved in all time periods.

C.2.6 Capacity Analysis Description

The performance of the intersections within the study area was evaluated as part of the VISSIM modeling effort. Table 1 and Table 2 display the LOS criteria for signalized and unsignalized intersections, respectively. The LOS criteria utilized for the analysis are contained within the most recent edition of the *Highway Capacity Manual*.

Table 1: Level of Service Definitions for Signalized Intersections

Level-of-Service	Description	Average Control Delay Per Vehicle (seconds)
A	Operations with very low control delay occurring with favorable progression and/or short cycle lengths.	≤ 10.0
B	Operations with low control delay occurring with good progression and/or short cycle lengths.	> 10.0 and ≤ 20.0
C	Operations with average control delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear.	> 20.0 and ≤ 35.0
D	Operations with longer control delays due to a combination of unfavorable progression, long cycle lengths, or high V/C ratios. Many vehicles stop and individual cycle failures are noticeable.	> 35.0 and ≤ 55.0
E	Operations with high control delay values indicating poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences. This is considered the limit of acceptable delay.	> 55.0 and ≤ 80.0
F	Operation with control delays unacceptable to most drivers occurring due to oversaturation, poor progression, or very long cycle lengths.	> 80.0

Source: 2016 Highway Capacity Manual 6th Edition, Transportation Research Board National Research Council

Table 2: Level of Service Definitions for Unsignalized Intersections

Level-of-Service	Description	Average Control Delay Per Vehicle (seconds)
A	Operations with very low control delay occurring with favorable progression and/or short cycle lengths.	≤ 10.0
B	Operations with low control delay occurring with good progression and/or short cycle lengths.	> 10.0 and ≤ 15.0
C	Operations with average control delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear.	> 15.0 and ≤ 25.0
D	Operations with longer control delays due to a combination of unfavorable progression, long cycle lengths, or high V/C ratios. Many vehicles stop and individual cycle failures are noticeable.	> 25.0 and ≤ 35.0
E	Operations with high control delay values indicating poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences. This is considered the limit of acceptable delay.	> 35.0 and ≤ 50.0
F	Operation with control delays unacceptable to most drivers occurring due to oversaturation, poor progression, or very long cycle lengths.	> 50.0

Source: 2016 Highway Capacity Manual 6th Edition, Transportation Research Board National Research Council

C.3 EXISTING CONDITIONS

The 2018 existing condition traffic volumes for the weekday AM, PM and MD weekend peak hours were developed through a blend of available data. Due to the COVID pandemic, traffic is

generally lighter than typical because of remote work and remote classes due to the proximity of the study area to the University of Buffalo. When balancing volumes, priority was weighted much heavier towards the volumes deemed most reliable that were collected pre-pandemic.

VISSIM requires that all traffic balance within the model between intersections/driveways. The general volume balancing methodology used by the project team was as follows:

- Where minor volume imbalances occurred between intersections, the through volumes were adjusted to always favor the higher volume intersection. In other words, the volumes were always adjusted up, not down, to provide a conservative approach.
- Where larger imbalances occurred (approximately 100 or more vehicles), artificial (dummy) driveways were placed to represent a major traffic generator that would account for this imbalance (e.g., cross streets not currently modeled as part of project area, commercial driveways, parking deck entrances/exits, etc.).

The 2018 AM and PM peak hours are shown in Figure 9 and the MD weekend peak hours are shown in Figure 4.

Table 3, Table 4, and Table 5 illustrate the LOS operational results for the AM, PM, and MD peak hours from the existing VISSIM models, respectively. The results are the average of 10 runs per time period using different random number seeds.

All study area intersections would operate at an overall LOS D or better during peak hours. The intersection with the worst LOS and greatest amount of delay is Dodge Road and John James Audubon Parkway. The delay experienced by the eastbound and westbound approach can be attributed to the left turn movements being conducted in a shared approach lane.

Table 6, Table 7, and Table 8 contain the average and max queue results for the AM, PM, and MD peak hours from the existing VISSIM models, respectively. The results are the average of 10 runs per time period using different random number seeds.

Figure 3: 2018 Existing AM & PM Weekday Peak Hour Volumes

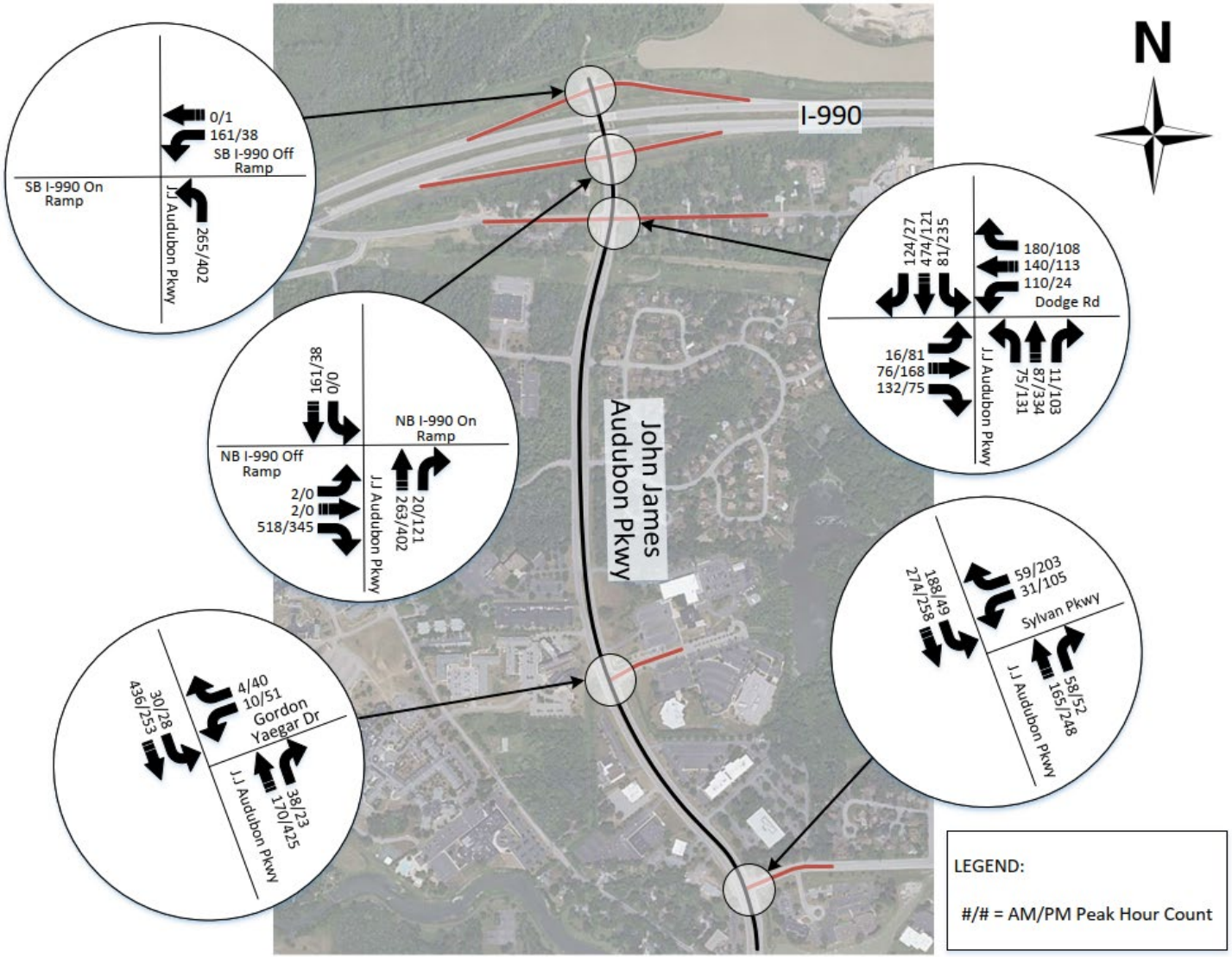


Figure 4: 2018 Existing MD Weekend Peak Hour Volumes

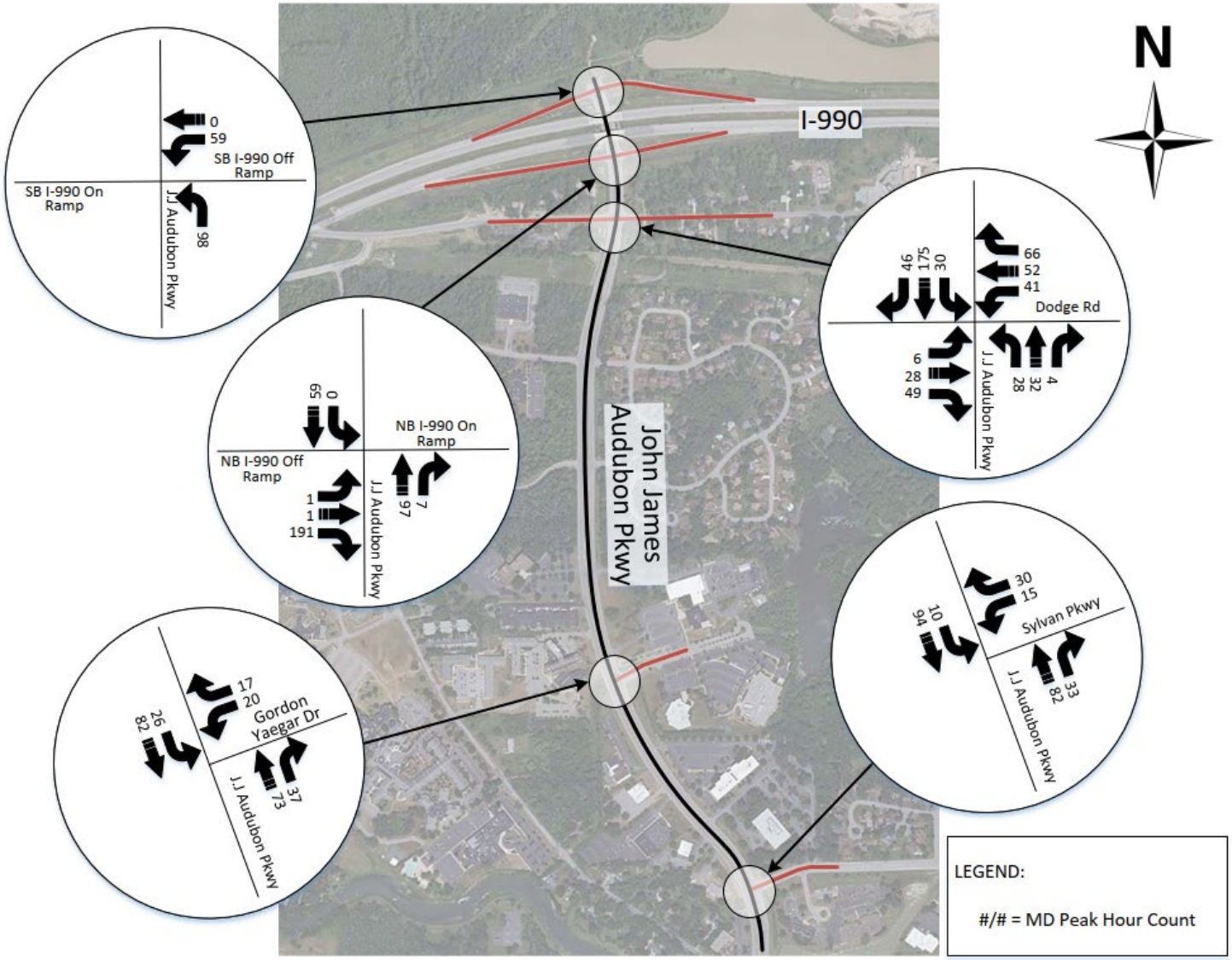


Table 3: Existing Weekday: AM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	A	A	N/A
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	A	A	N/A	A	N/A	N/A	N/A	N/A	A	N/A	A	A	A
	John James Audubon Pkwy and Dodge Rd	Signal	C	B	A	C	C	B	A	B	D	C	B	C	E	E	E	E	D
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C	N/A	C	C	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	A	N/A

Table 4: Existing Weekday: PM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	A	A	N/A
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	A	A	N/A	A	N/A	N/A	N/A	N/A	A	N/A	A	A	A
	John James Audubon Pkwy and Dodge Rd	Signal	D	C	B	C	C	B	A	C	E	E	D	E	D	C	B	C	C
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	B	B	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	A	N/A

Table 5: Existing Weekend: MD Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	A	A	N/A
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	A	A	N/A	A	N/A	N/A	N/A	N/A	A	N/A	A	A	A
	John James Audubon Pkwy and Dodge Rd	Signal	C	B	A	B	C	B	A	B	C	C	A	B	C	C	A	B	B
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	B	N/A	A	A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	A	N/A

Table 6: Existing Weekday: AM Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	2	94
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	0	30	0	70	N/A	N/A	1	55
	John James Audubon Pkwy and Dodge Rd	Signal	9	123	31	215	35	295	220	816
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	42	543	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	11	127

Table 7: Existing Weekday: PM Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	11	134
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	2	76	1	67	N/A	N/A	3	83
	John James Audubon Pkwy and Dodge Rd	Signal	23	221	31	234	115	527	39	299
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	43	234	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	2	92

Table 8: Existing Weekend: MD Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	1	86
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	0	33	0	37	N/A	N/A	1	64
	John James Audubon Pkwy and Dodge Rd	Signal	2	80	6	98	7	112	13	159
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	16	148	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	3	100

C.4 PROJECTED TRAFFIC CONDITIONS

C.4.1 Background Traffic Growth

As part of the analysis, future conditions were also analyzed. This process involved growing the existing traffic demand to the estimated volumes of the target future year (2040). The growth rates were applied on a corridor level to the network and were based on estimated travel demand from a TransCAD Regional Travel Demand Model provided by GBNRTC. Any negative growth rates identified were assumed to be 0% growth to be conservative. Table 9 contains the effective 22-year growth rate implemented for the No Build Alternative, LRT Build Alternative, and BRT Build Alternative models during the weekday morning (AM), weekday evening (PM), and Saturday midday peak hours.

Table 9: Effective Corridor Growth Rates for Future Conditions

Corridor	Percent Change					
	No Build Alternative			Build Alternatives		
	AM	PM	MD	AM	PM	MD
John James Audubon Pkwy	0%	3%	4%	0%	2%	4%

C.4.2 Muir Woods Student Housing Development

To address the impacts of the planned development north of the I-990 interchange with John James Audubon Parkway, additional forecasted trips were added to the background growths stated earlier. The trip generation and trip distribution were maintained from the *Access Modification Report for Break In Access Application for the Northerly Extension of John James Audubon Parkway* conducted by GPI in 2020. The anticipated trips from this report can be seen in Figure 5 through Figure 8. The ITE trip generation is limited to forecasted trips during the AM and PM weekday peak hours. To be conservative, the higher PM peak forecasted trips were applied to the MD weekend peak hour.

Figure 5: Muir Woods AM Peak Hour Trip Generation

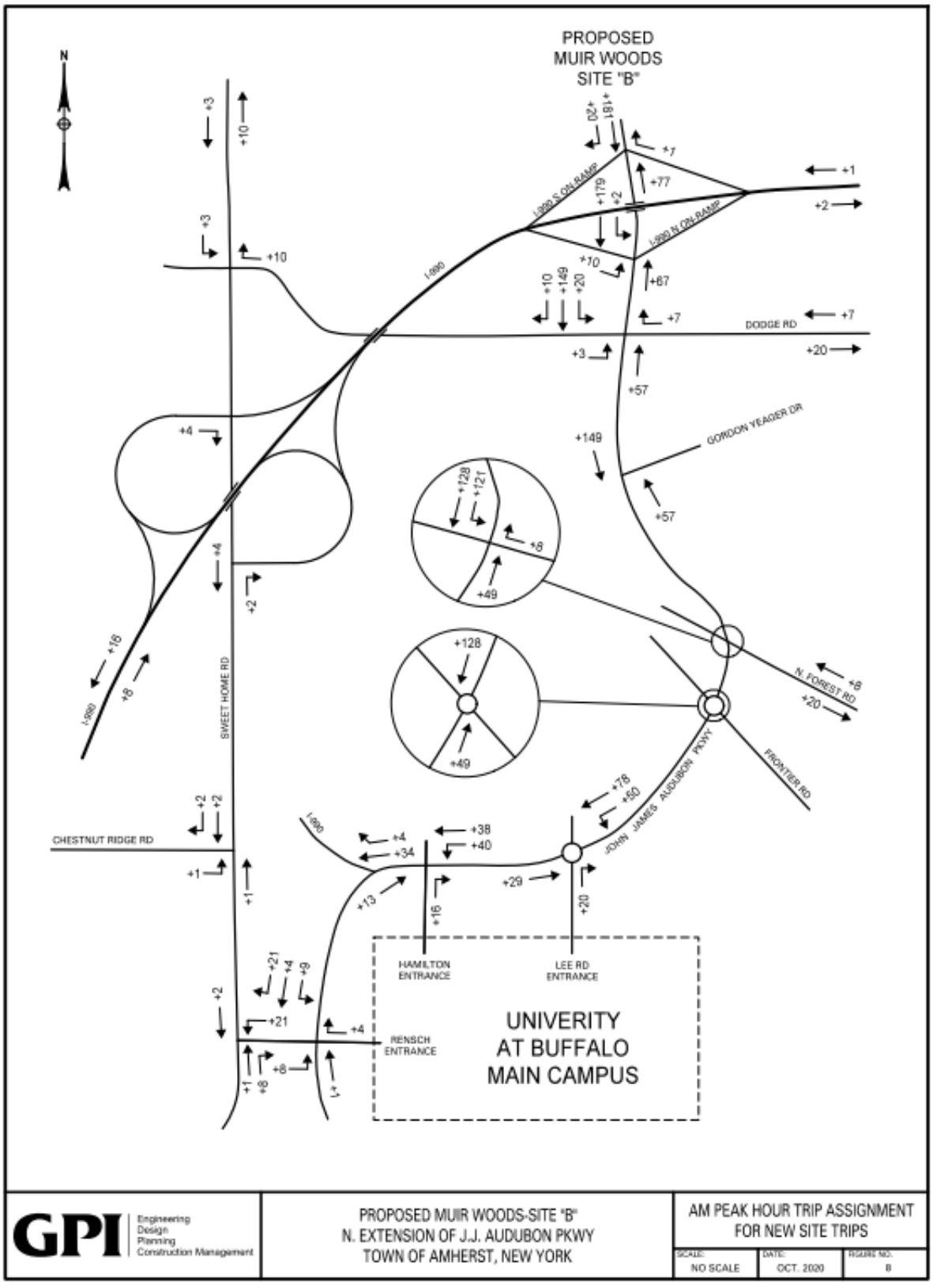


Figure 6: Muir Woods PM Peak Hour Trip Generation

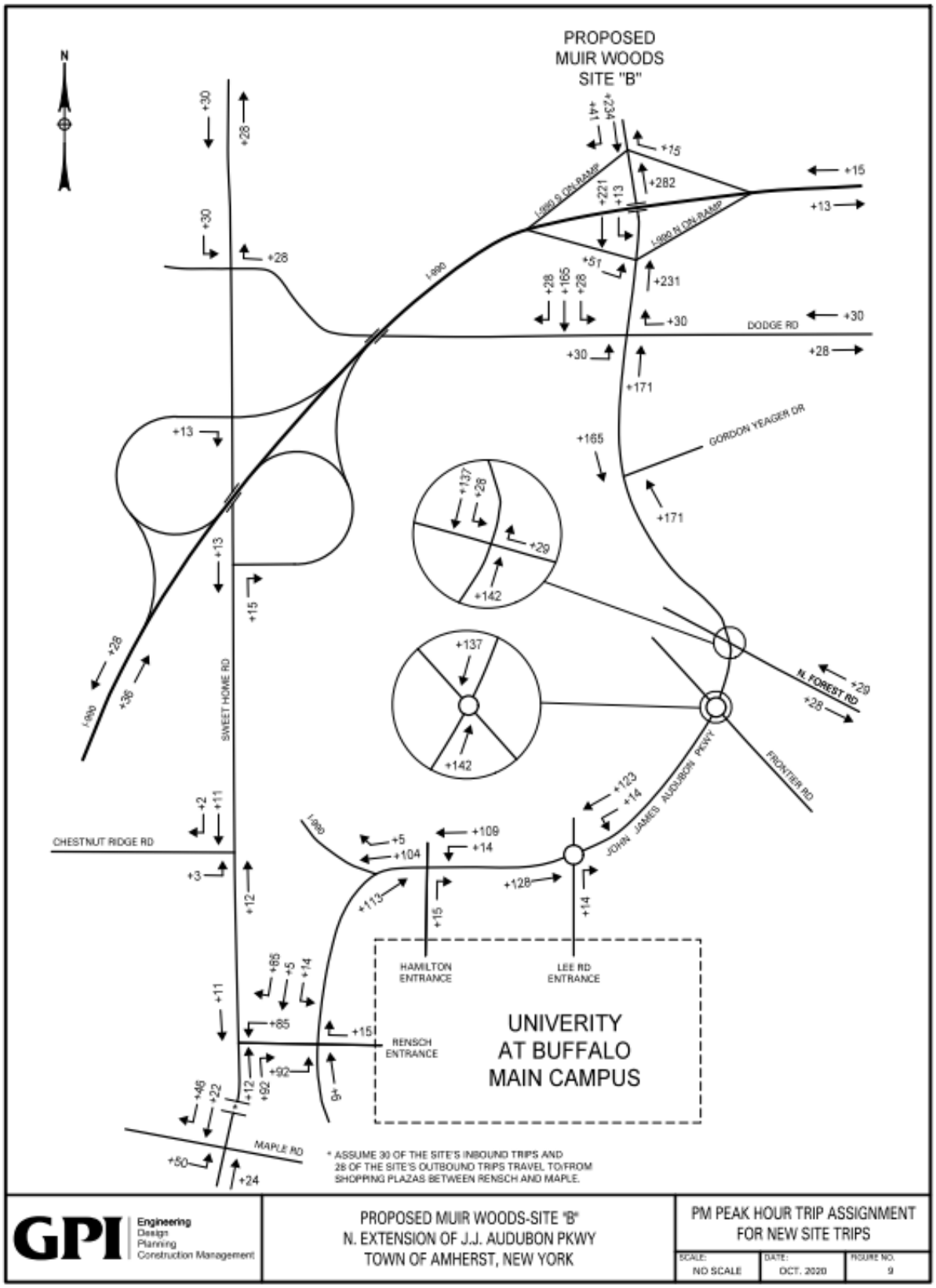


Figure 7: 2040 No Build Alternative AM & PM Weekday Peak Hour Volumes

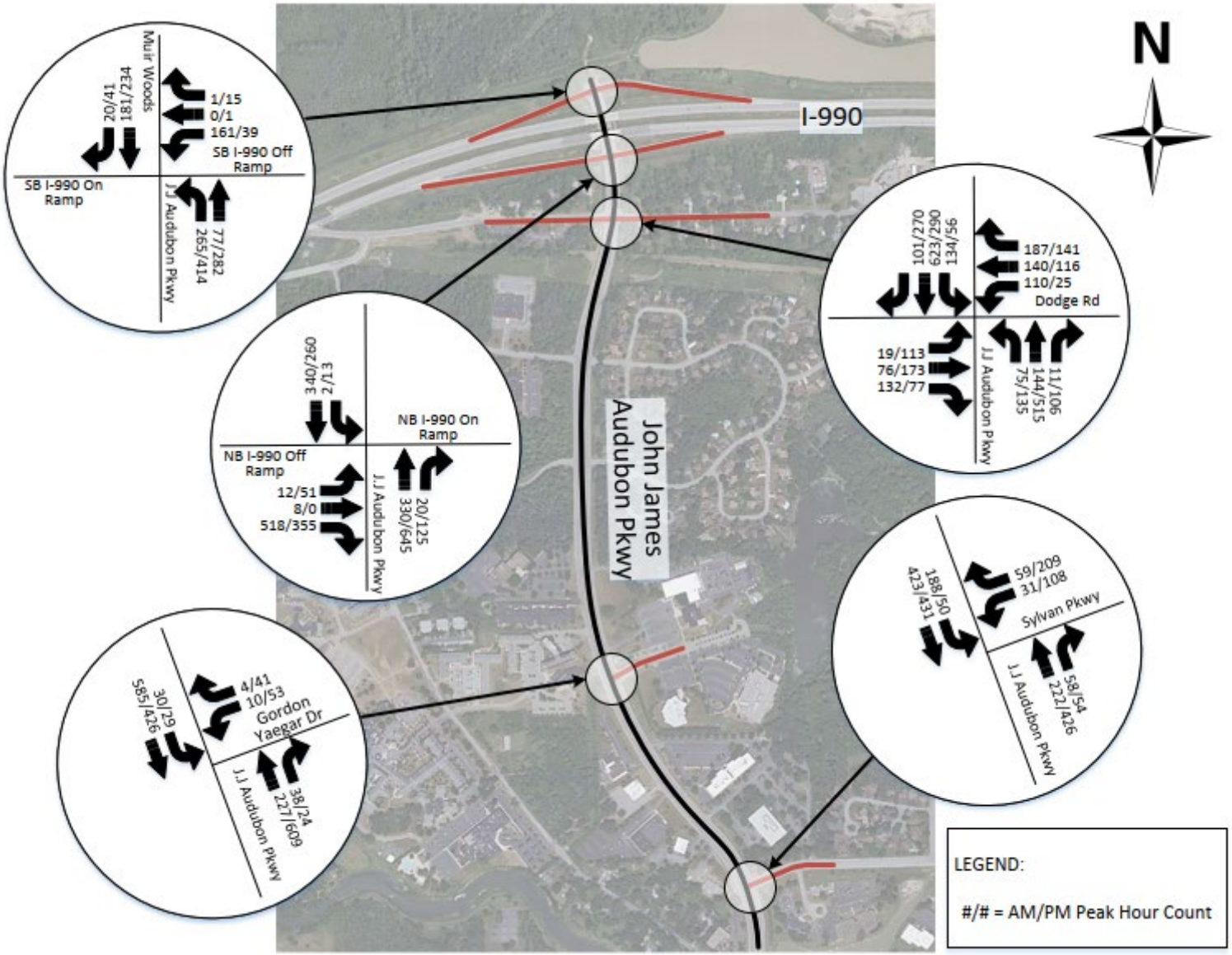


Figure 8: 2040 No Build Alternative MD Weekend Peak Hour Volumes

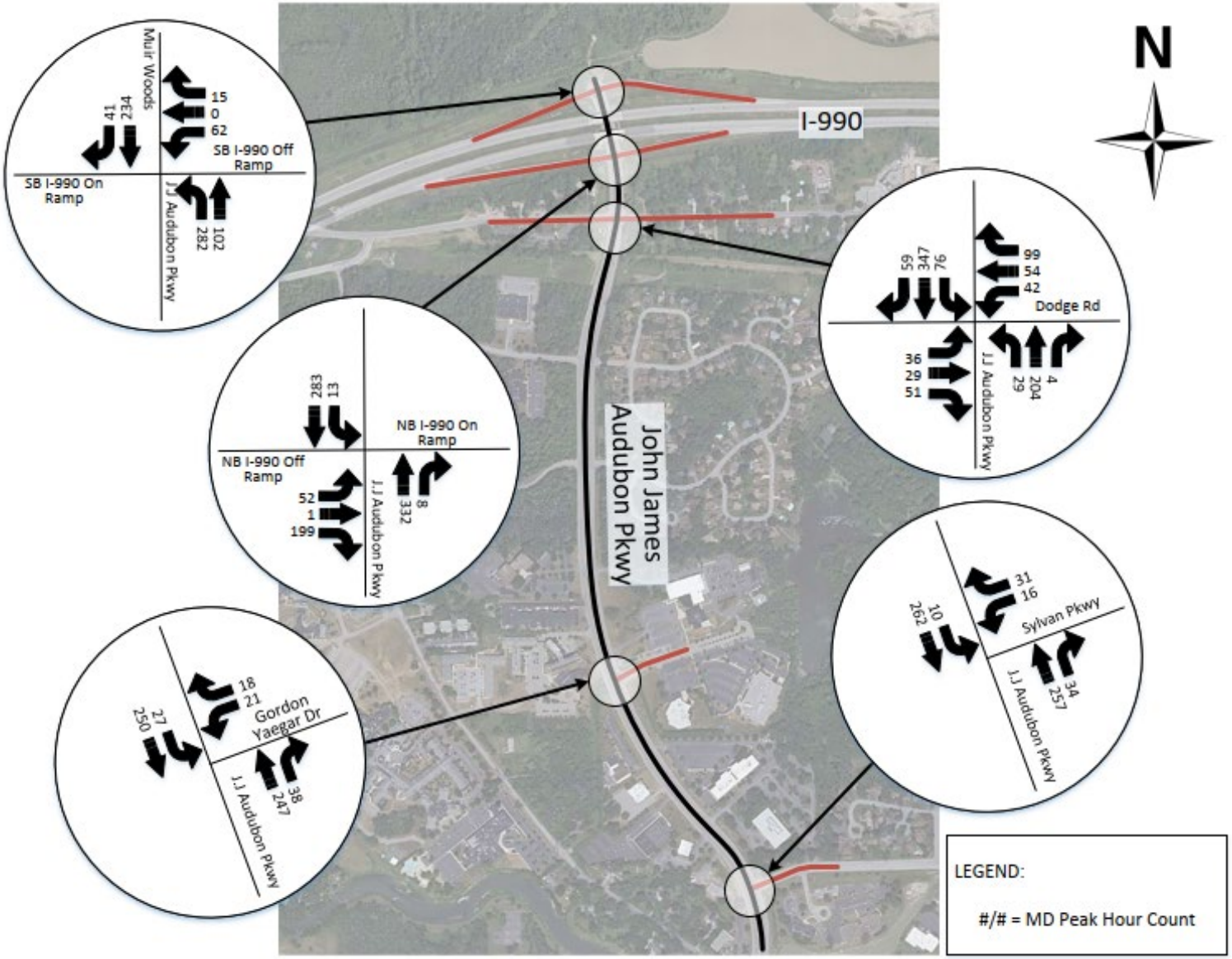


Figure 9: 2040 Build AM & PM Weekday Peak Hour Volumes

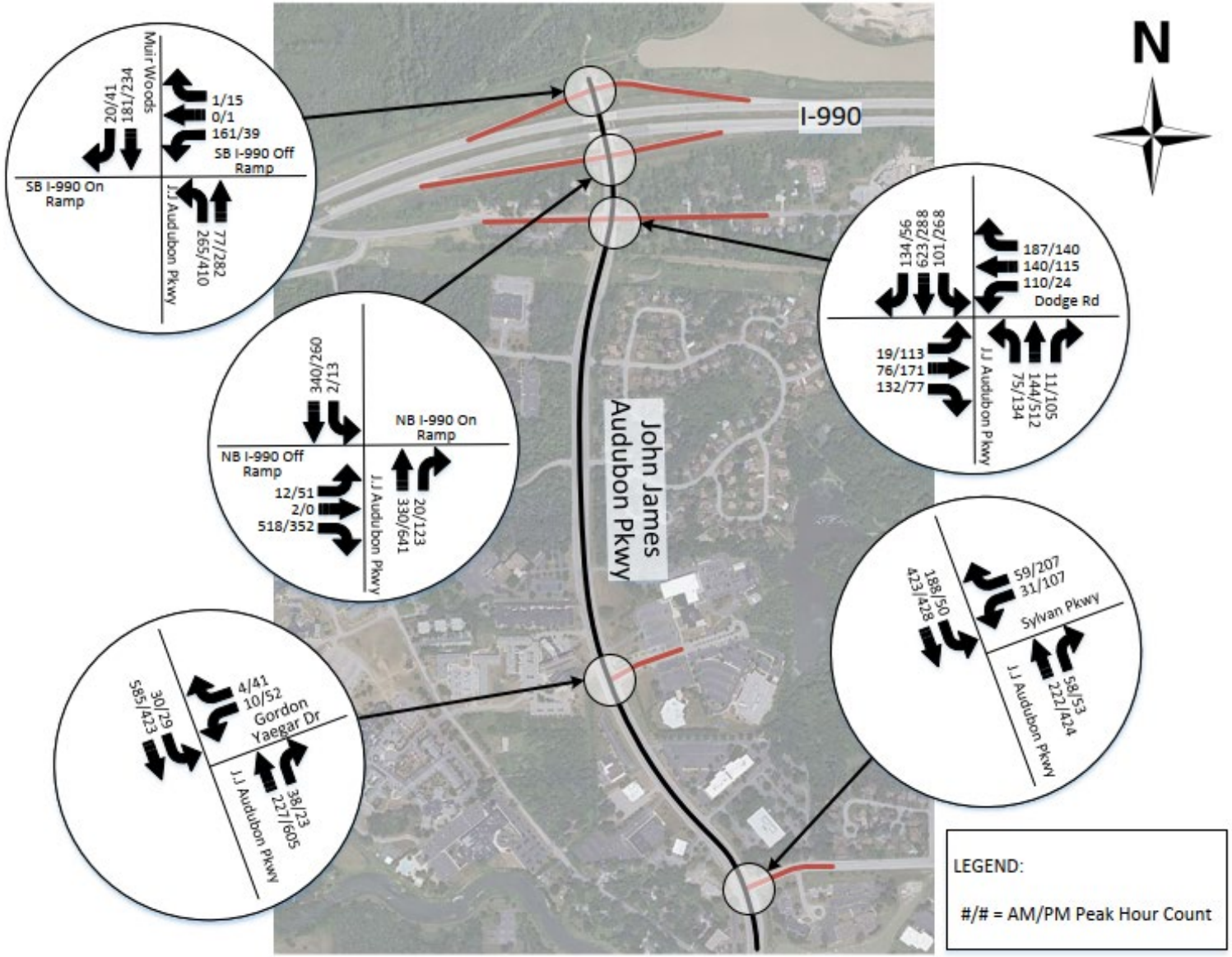
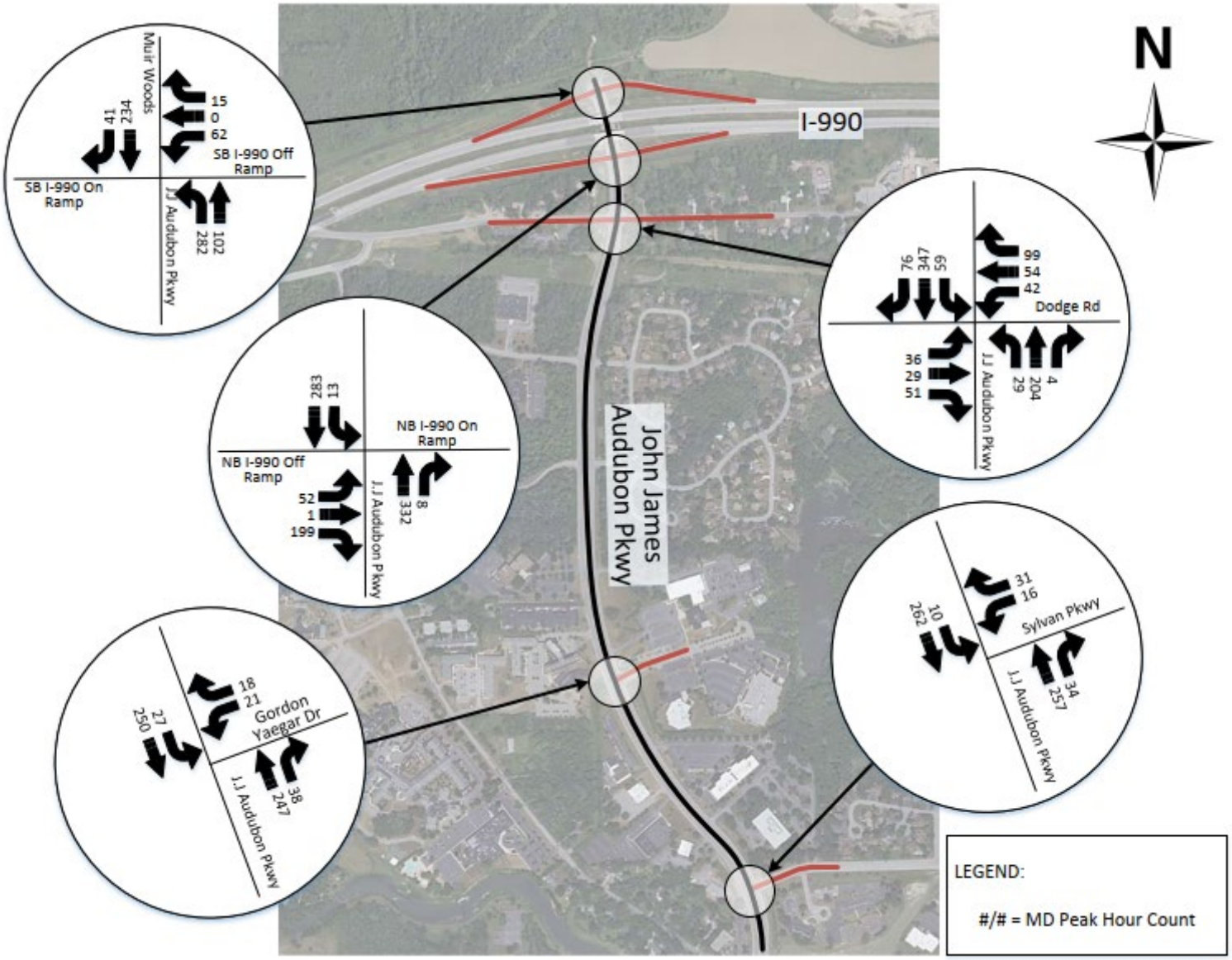


Figure 10: 2040 Build MD Weekend Peak Hour Volumes



C.5 NO BUILD ALTERNATIVE

To prepare a comparative alternative to the Build Alternatives, a 2040 design year No Build VISSIM model was constructed. This model used an identical network to the existing conditions previously modeled with the exception of the planned single circulating lane roundabout at the I-990 SB off-ramp as proposed by the Muir Woods development. Traffic volumes were adjusted utilizing the growth rates to simulate the expected demand and the additional traffic due to the Muir Woods development. Note that this alternative utilized optimized signal timings at signalized intersections.

Table 10, Table 11, and Table 12 illustrate the LOS operational results for the AM, PM, and MD peak hours from the No Build Alternative VISSIM models, respectively. The results are the average of 10 runs per time period using different random number seeds. All individual movements and all intersections would operate at a LOS of D or better during peak hours.

Table 13, Table 14, and Table 15 contain the average and max queue results for the AM, PM, and MD peak hours from the No Build Alternative VISSIM models, respectively. The results are the average of 10 runs per time period using different random number seeds.

Table 10: No Build Alternative Weekday: AM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall	
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach		
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	Delay	LOS
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	B	N/A	A	A	8.1	N/A
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	A	N/A	N/A	A	N/A	N/A	N/A	N/A	B	N/A	A	A	0.8	A
	John James Audubon Pkwy and Dodge Rd	Signal	C	B	A	C	C	C	B	C	C	C	B	B	D	D	D	D	27.1	C
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	N/A	D	D	N/A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	2.8	A

Table 11: No Build Alternative Weekday: PM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall	
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach		
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	Delay	LOS
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	B	N/A	A	A	9.4	N/A
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	A	N/A	N/A	A	N/A	N/A	N/A	N/A	B	N/A	A	A	3.2	A
	John James Audubon Pkwy and Dodge Rd	Signal	D	C	B	C	D	C	A	C	D	D	D	D	C	C	B	C	31.5	C
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C	N/A	C	C	N/A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	A	A	N/A	A	A	A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	3.9	A

Table 12: No Build Alternative Weekend: MD Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall	
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach		
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	Delay	LOS
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	A	A	7.4	N/A
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	A	N/A	N/A	A	N/A	N/A	N/A	N/A	A	N/A	A	A	1.7	A
	John James Audubon Pkwy and Dodge Rd	Signal	C	B	A	B	C	B	A	B	C	C	A	B	C	C	B	B	14.7	B
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	B	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	1.8	A

Table 13: No Build Alternative Weekday: AM Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	2	94
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	0	48	1	89	N/A	N/A	1	55
	John James Audubon Pkwy and Dodge Rd	Signal	11	132	49	334	29	266	122	606
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	131	872	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	19	6	179	N/A	N/A	1	74

** Red Cells: Queue that is exceeding available storage or reaches upstream intersection*

Table 14: No Build Alternative Weekday: PM Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	12	120
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	3	99	2	96	N/A	N/A	4	90
	John James Audubon Pkwy and Dodge Rd	Signal	43	296	39	290	112	516	38	299
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	68	318	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	13	7	169	N/A	N/A	1	66

Table 15: No Build Alternative Weekend: MD Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Stop	N/A	N/A	N/A	N/A	N/A	N/A	1	87
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	1	53	1	62	N/A	N/A	1	67
	John James Audubon Pkwy and Dodge Rd	Signal	7	123	11	131	12	147	17	185
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	23	178	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	0	1	95	N/A	N/A	0	43

C.6 LRT BUILD ALTERNATIVE

A VISSIM LRT Build Alternative model was developed for a future 2040 year analysis to determine the operational impacts of including the LRT system within the study area and to determine the feasibility of incorporating the system within the current critical network (which includes the roundabout within the John James Audubon Parkway and the Southbound I-990 ramps).

C.6.1 Modeling Assumptions

For the LRT Build Alternative, trains would operate in three-car sets, seven days a week from 5:00 a.m. to 1:00 a.m. At all at-grade crossings, gates and signals will be installed as an operational and safety measure.

The service would generally operate on the following frequencies:

1) Weekday peak-period service (i.e., 6:30 a.m. to 9:30 a.m. and 4:00 p.m. to 6:00 p.m.) would be every 10 minutes.

2) Signal Preemption: Active at all signalized intersections

3) Vehicle Dimensions: 200 ft train length (3 car)

4) Stop Dwell Time: 45 secs

5) LRT Acceleration Profile at stations:

   a) Desired Acceleration: 3.28ft/s^2

   b) Max Acceleration: 3.3ft/s^2

   c) Desired Deceleration: -2.79 ft/s^2

   d) Max Deceleration:

      i) @ 0 mph is -16.40 ft/s^2

      ii) @ 40 mph is -14.30 ft/s^2

6) At-Grade crossing operations (Gate Assumptions):

   a) Advanced Warning - Lights flashing, gate lowering, prior to train arriving at the crossing = 20 seconds

   b) 300’ long train proceeding through crossing @ 10mph = 20 seconds (Assumes 300’ long consist based on platform length)

c) Clear gates and signals – Time for gate to raise after train departs crossing = 15 seconds

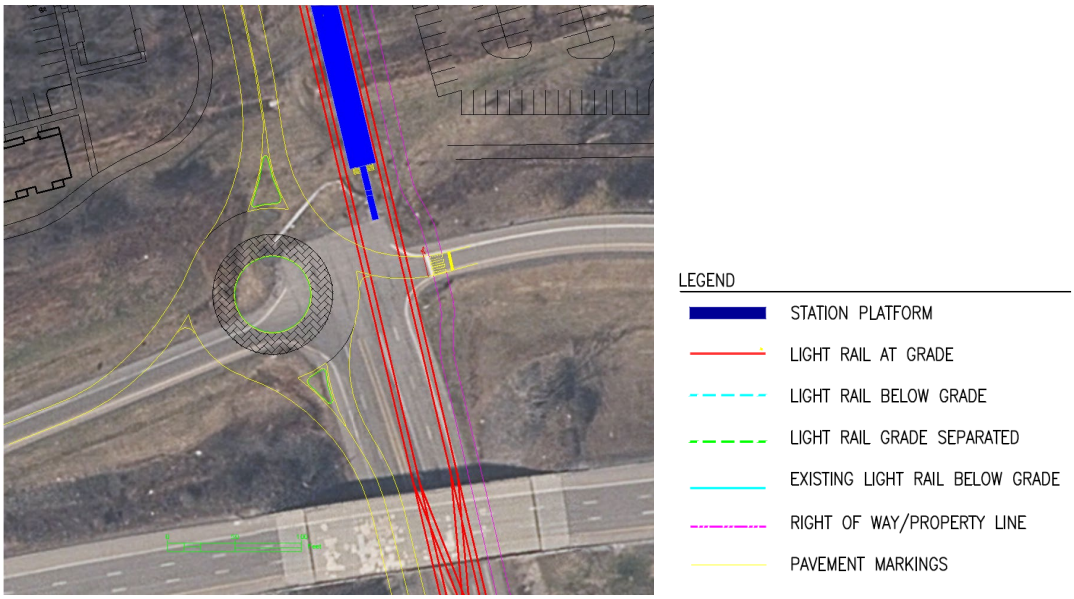
d) Roadway traffic impact from railroad crossing activation = 55 seconds

C.6.2 Required Network Changes

During conceptual design for the Project, the introduction of a roundabout as part of the roadway improvements required for the construction of the Muir Woods Student Housing development prompted new safety concerns. Those concerns revolved around LRT tracks traversing through the middle of the roundabout, creating multiple points of conflicts between the LRT and general vehicles. In addition, the inclusion of the LRT system within the existing roadway network would require a lane reduction along the John James Audubon Parkway corridor. The proposed LRT alignment would be located on the Northbound John James Audubon Parkway travel lanes and the southbound lanes would be converted into an undivided, two-lane roadway.

For the roundabout to work from an operational and safety perspective, the Project will reconstruct the proposed roundabout being constructed for the Muir Woods Student Housing development by shifting the roundabout to the west approximately 60 feet. By shifting the roundabout, the LRT tracks would traverse across only the I-990 Southbound off ramp as depicted in Figure 11. By only introducing one conflict point on the off ramp, there is a safety improvement by only creating one (1) at-grade crossing, which would install gates and signals to enhance the safety operations on the off ramp. A signage plan has also been developed identifying the proper signage required for the roundabout, as depicted in Section C.9.

Figure 11: Proposed Geometry at Southbound I-990



C.6.3 Capacity Improvements

The LRT Build Alternative VISSIM models were tested with the required network changes previously mentioned and existing signal timings. Upon inspection of the results, the network experienced severe queuing and delay due to significant capacity reductions due to the integration of the LRT extension, unoptimized and uncoordinated signalization, and LRT preemption demand. To counteract this, capacity improvements will be required to achieve acceptable metrics along the network. These capacity improvements are assumed to be included within cost and construction of the LRT Build Alternative. The capacity improvements in the LRT Build Alternative VISSIM models are as follows:

- John James Audubon Parkway and Southbound I-990
    - Reconstruction of the proposed Muir Woods Roundabout to the west to allow LRT at-grade crossing of the Southbound I-990 off ramp approach.
- John James Audubon Parkway and Northbound I-990
    - Northbound I-990 off ramp approach: Addition of a 250 ft dedicated right turn lane as proposed by the Muir Woods development Traffic Impact Study.
- John James Audubon Parkway and Dodge Road
    - Addition of a shared through/right lane from Northbound I-990 terminal. This lane is carried through the intersection and terminates approximately 250 ft to the south.
    - Addition of 100 ft Eastbound and Westbound dedicated left turn lanes.
- John James Audubon Parkway and Sylvan Parkway
    - Signalize intersection

Table 16, Table 17, and Table 18 illustrate the LOS operational results for the weekday AM, weekday PM, and Saturday MD peak hours from the LRT Build Alternative VISSIM models, respectively. The results are the average of 10 runs per time period using different random number seeds. All intersections operate at a LOS of D or better during all time periods. The westbound approach at the intersection of John James Audubon Parkway and Dodge Road is anticipated to operate at LOS F with the Northbound left turn also operating at LOS F during the PM peak hour.

Table 19, Table 20, and Table 21 contain the average and max queue results for the AM, PM, and MD peak hours from the LRT Build Alternative VISSIM models, respectively. The results are the average of 10 runs using different random number seeds.

Table 16: LRT Build Alternative with Roundabout Weekday: AM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	A	A	A	C	A	N/A	A	N/A	N/A	N/A	N/A	D	N/A	B	C	B
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	A	B	A
	John James Audubon Pkwy and Dodge Rd	Signal	E	B	A	C	D	C	B	C	C	D	C	D	D	E	D	D	C
	John James Audubon Pkwy and I-990 EB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	A	A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 WB Off Ramp	Roundabout	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	A

Table 17: LRT Build Alternative with Roundabout Weekday: PM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	B	A	B	D	A	N/A	A	N/A	N/A	N/A	N/A	D	N/A	C	C	B
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	B	A	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	A	B	A
	John James Audubon Pkwy and Dodge Rd	Signal	F	D	D	D	E	B	A	D	D	D	D	D	E	F	E	F	D
	John James Audubon Pkwy and I-990 EB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C	N/A	B	B	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 WB Off Ramp	Roundabout	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	A

Table 18: LRT Build Alternative with Roundabout Weekend: MD Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	A	A	A	C	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	B	C	A
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	A	B	A
	John James Audubon Pkwy and Dodge Rd	Signal	D	B	B	B	D	B	A	B	C	C	A	C	C	D	B	C	B
	John James Audubon Pkwy and I-990 EB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	A	A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 WB Off Ramp	Roundabout	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	A

Table 19: LRT Build Alternative with Roundabout Weekday: AM Peak Hour Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	6	138	9	353	N/A	N/A	4	93
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	4	152	2	194	N/A	N/A	1	55
	John James Audubon Pkwy and Dodge Rd	Signal	15	184	39	284	46	309	88	541
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	9	180	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	23	2	98	N/A	N/A	2	104

Table 20: LRT Build Alternative with Roundabout Weekday: PM Peak Hour Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	17	272	9	264	N/A	N/A	22	208
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	23	338	3	183	N/A	N/A	7	106
	John James Audubon Pkwy and Dodge Rd	Signal	190	939	51	401	59	419	129	565
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	24	178	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	46	3	127	N/A	N/A	1	36

** Red Cells: Queue that is exceeding available storage or reaches upstream intersection*

Table 21: LRT Build Alternative with Roundabout Weekend: MD Peak Hour Levels of Service (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	4	117	1	105	N/A	N/A	2	85
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	5	143	1	106	N/A	N/A	2	65
	John James Audubon Pkwy and Dodge Rd	Signal	11	167	13	155	8	111	15	170
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	0	55	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	23	0	65	N/A	N/A	1	53

C.6.4 Signalized Intersection

The LRT Build Alternative was also evaluated as a signalized intersection with the southbound I-990 ramps. This option was tested with the required network changes previously mentioned to determine which of the two intersection improvements would operate more efficiently and safer. Implementing a traffic signal at this location, even without meeting traditional signal warrants, helps mitigate the risks of at-grade rail crossings. Traffic signals provide clear indications to drivers and pedestrians, thus reducing the risk of possible train collisions.

Figure 12 depicts the geometry for the I-990 southbound terminal. The southbound and westbound approaches consist of a single lane approach and the northbound approach consists of left turn lane and a thru lane.

Figure 12: Proposed Geometry with Southbound I-990

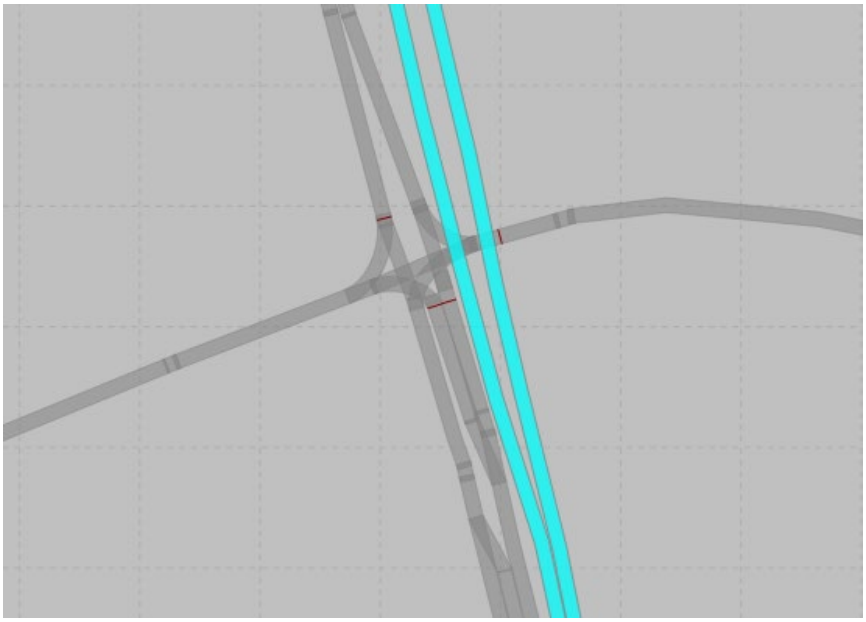


Table 22, Table 23, and Table 24 illustrate the LOS operational results for the AM, PM, and MD peak hours from the LRT Build Alternative signalized intersection VISSIM models. The results are the average of 10 runs per time period using different random number seeds. All intersections operate at a LOS of D or better during all time periods. The westbound approach at the intersection of John James Audubon Parkway and Dodge Road is anticipated to operate at LOS F with the northbound left turn also operating at LOS F during the PM peak hour.

Table 25, Table 26, and Table 27 contain the average and max queue results for the AM, PM, and MD peak hours from the LRT Build Alternative signalized intersection VISSIM models, respectively. The results are the average of 10 runs per time period using different random number seeds.

Table 22: LRT Build Alternative with Signal Weekday: AM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	B	A	A	C	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	B	C	B
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	A	B	A
	John James Audubon Pkwy and Dodge Rd	Signal	E	B	A	C	D	C	B	C	C	D	C	D	A	E	D	D	C
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	B	N/A	A	A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Signal	A	A	N/A	A	N/A	B	A	B	N/A	N/A	N/A	N/A	C	A	A	C	B

Table 23: LRT Build Alternative with Signal Weekday: PM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	B	B	B	C	B	N/A	B	N/A	N/A	N/A	N/A	C	N/A	B	C	B
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	B	A	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	B	B	A
	John James Audubon Pkwy and Dodge Rd	Signal	F	D	D	D	E	B	B	D	D	D	D	D	E	F	E	F	D
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C	N/A	B	B	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Signal	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	C	A	C	C	A

Table 24: LRT Build Alternative with Signal Weekend: MD Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	A	A	A	C	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	B	B	A
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	A	B	A
	John James Audubon Pkwy and Dodge Rd	Signal	D	B	A	B	D	B	A	B	C	D	A	C	C	D	B	C	B
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	A	A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Signal	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	C	A	C	C	A

Table 25: LRT Build Alternative with Signal Weekday: AM Peak Hour Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	7	148	9	309	N/A	N/A	4	95
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	4	136	2	220	N/A	N/A	1	56
	John James Audubon Pkwy and Dodge Rd	Signal	15	180	40	306	46	308	88	543
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	9	171	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Signal	8	169	10	172	N/A	N/A	23	161

** Red Cells: Queue that is exceeding available storage or reaches upstream intersection*

Table 26: LRT Build Alternative with Signal Weekday: PM Peak Hour Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	18	268	14	274	N/A	N/A	23	216
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	23	315	3	200	N/A	N/A	7	92
	John James Audubon Pkwy and Dodge Rd	Signal	171	892	52	424	60	437	121	533
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	23	186	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Signal	8	285	10	167	N/A	N/A	7	90

** Red Cells: Queue that is exceeding available storage or reaches upstream intersection*

Table 27: LRT Build Alternative with Signal Weekend: MD Peak Hour Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	4	122	1	102	N/A	N/A	2	85
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	4	146	1	82	N/A	N/A	2	63
	John James Audubon Pkwy and Dodge Rd	Signal	11	181	13	157	8	115	15	175
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	0	53	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Signal	2	140	6	149	N/A	N/A	10	100

C.6.5 Sensitivity Analysis

To determine the operational resiliency of the I-990 terminal intersections with increased transit service, a worst-case scenario was tested. In this worst-case scenario, the LRT headways were decreased to 7.5 minutes and an extra car was added (train length 264 ft). These transit parameters were tested utilizing the LRT Build Alternative VISSIM models with a roundabout at the Southbound I-990 terminal.

Table 28, Table 29, and Table 30 illustrate the AM, MD, and PM peak hour operational results from the LRT Build Alternative sensitivity VISSIM models, respectively. The results are the average of 10 runs per time period using different random number seeds. All intersections operate at an overall LOS of D or better during all time periods with the exception of the intersection of John James Audubon Parkway and Dodge Road during the PM peak hour, which operates at a LOS E. In addition, the westbound approach at this intersection is anticipated to operate at LOS F, with the northbound left turn also operating at LOS F during the PM peak hour.

Table 31, Table 32, and Table 33 contain the average and max queue results for the AM, PM, and MD peak hour LRT Build Alternative sensitivity VISSIM models, respectively. The results are the average of 10 runs using different random number seeds.

Table 28: LRT Build Alternative Sensitivity Weekday: AM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	B	A	B	C	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	C	C	B
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	A	B	A
	John James Audubon Pkwy and Dodge Rd	Signal	E	B	A	C	E	B	B	C	D	E	D	D	A	E	E	E	D
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	B	N/A	A	A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	A

Table 29: LRT Build Alternative Sensitivity Weekday: PM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	B	B	B	C	B	N/A	C	N/A	N/A	N/A	N/A	C	N/A	C	C	C
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	B	B	A
	John James Audubon Pkwy and Dodge Rd	Signal	F	D	D	E	E	B	A	D	D	D	D	D	F	F	F	F	E
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C	N/A	C	C	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	A	N/A	A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	A

Table 30 LRT Build Alternative Sensitivity Weekend: MD Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	A	B	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	B	B	A
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	N/A	A	A	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	A	B	A
	John James Audubon Pkwy and Dodge Rd	Signal	D	B	A	B	D	B	A	B	D	D	B	C	C	D	B	C	B
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	A	A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	A

Table 31: LRT Build Alternative Sensitivity Weekday: AM Peak Hour Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	7	147	8	212	N/A	N/A	5	90
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	20	265	2	165	N/A	N/A	1	54
	John James Audubon Pkwy and Dodge Rd	Signal	60	222	41	304	102	394	164	634
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	85	290	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	16	23	128	N/A	N/A	56	211

** Red Cells: Queue that is exceeding available storage or reaches upstream intersection*

Table 32: LRT Build Alternative Sensitivity Weekday: PM Peak Hour Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	20	310	15	289	N/A	N/A	27	207
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	21	299	3	171	N/A	N/A	7	92
	John James Audubon Pkwy and Dodge Rd	Signal	207	989	57	431	62	452	159	616
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	30	224	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	127	3	108	N/A	N/A	1	59

** Red Cells: Queue that is exceeding available storage or reaches upstream intersection*

Table 33: LRT Build Alternative Sensitivity Weekend: MD Peak Hour Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	4	130	1	106	N/A	N/A	2	76
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	5	135	1	93	N/A	N/A	2	65
	John James Audubon Pkwy and Dodge Rd	Signal	10	155	13	156	10	123	17	171
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	0	57	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	37	0	64	N/A	N/A	1	50

C.6.6 LRT Build Alternative

Based on the analysis presented in this AMR, the recommendation for the LRT Build Alternative is to continue to operate a single lane roundabout that provides one circulating lane. In this configuration, the roundabout shifts approximately 100 feet to the west in order to construct the LRT Build Alternative track alignment traversing across the I-990 Southbound off ramp. This option is depicted in Figure 11 in Section C.6.2. This option allows for the northerly extension of John James Audubon Parkway to continue to operate as a public roadway into the Muir Woods Student Housing development. In addition, gates and signals would be constructed on the I-990 Southbound off ramp for safety protection between the transit vehicle and the general-purpose vehicles.

C.7 BRT BUILD ALTERNATIVE

The purpose of this BRT Build Alternative model was to determine the operational impacts of including the BRT system within the study area and to determine the feasibility of incorporating the system within the current roadway network (which includes the roundabout within the John James Audubon Parkway and the Southbound I-990 ramps).

C.7.1 Modeling Assumptions

For the BRT Build Alternative, BRT vehicles would operate seven days a week from 5:00 a.m. to 1:00 a.m. On occasion, for special events, extra BRT vehicles would be used. The service would generally operate on the following frequencies:

1. Weekday peak-period service (i.e., 6:30 a.m. to 9:30 a.m. and 4:00 p.m. to 6:00 p.m.) would be every 5 minutes
2. Transit Signal Priority: Active at all signalized intersections
    a. 10 second maximum early or extend of priority phase
3. Vehicle Dimensions: 60-foot articulated bus
4. Stop Dwell Time: 45 seconds

C.7.2 Required Network Changes

The BRT Build Alternative would operate in the same dedicated ROW as the LRT Build Alternative until Dodge Road. However, the BRT Build Alternative would run in mixed traffic. Therefore, it would not be necessary to reconstruct the Southbound I-990 roundabout to facilitate a dedicated BRT service. The BRT Build Alternative would transition to mixed operations at the John James Audubon Parkway and Dodge Road intersection as seen in Figure 13.

Figure 13: BRT Build Alternative Transition to Mixed Operations

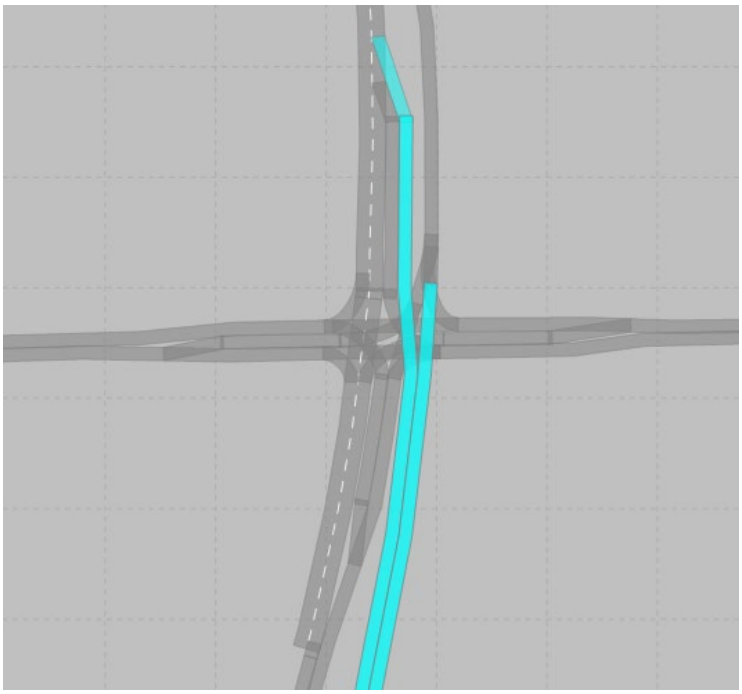


Figure 14 depicts the geometry of how the BRT Build Alternative would transition out of the roundabout into the Muir Woods Station. Only northbound BRT vehicles would stop at this station before continuing north utilizing the internal Muir Woods roadway network to traverse through the second roundabout in order to head south.

Figure 14: BRT Build Alternative Geometry with Roundabout

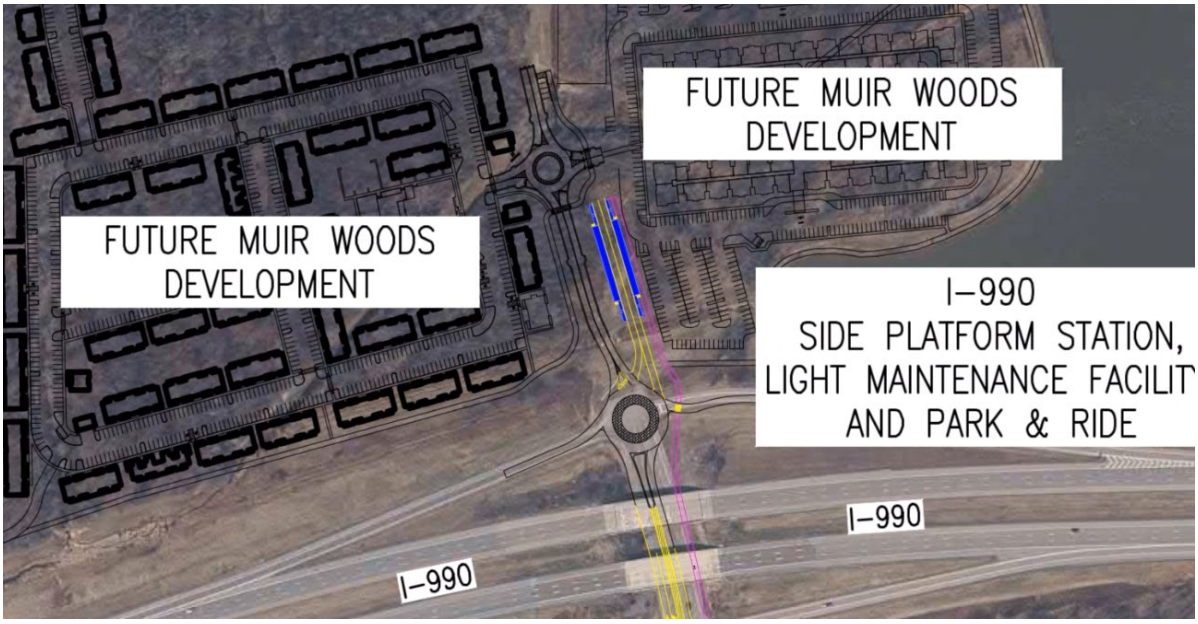


Table 34, Table 35, and Table 36 illustrate the LOS operational results for the AM, PM, and MD peak hours from the BRT Build Alternative VISSIM models, respectively. The results are the average of 10 runs per time period using different random number seeds. All intersections operate at a LOS of D or better during all time periods. The northbound approach at the intersection of John James Audubon Parkway and Dodge Road is anticipated to operate at LOS E with the eastbound left turn also operating at LOS E during the PM peak hour.

Table 37, Table 38, and Table 39 contain the average and max queue results for the AM, PM, and MD peak hours from the BRT Build Alternative VISSIM models, respectively. The results are the average of ten runs per time period using different random number seeds.

Table 34: BRT Build Alternative Weekday: AM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	A	B	B	C	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	C	C	B
	John James Audubon Pkwy and Gordon R Yaeger	Signal	N/A	A	A	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	C	C	A
	John James Audubon Pkwy and Dodge Rd	Signal	D	C	C	C	D	B	B	C	C	C	B	B	C	C	C	C	C
	John James Audubon Pkwy and I-990 NB Off	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	B	N/A	A	A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off	Roundabout	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	A

Table 35: BRT Build Alternative Weekday: PM Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	B	B	B	C	B	N/A	B	N/A	N/A	N/A	N/A	C	N/A	C	C	C
	John James Audubon Pkwy and Gordon R Yaeger	Signal	N/A	B	B	B	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	C	C	A
	John James Audubon Pkwy and Dodge Rd	Signal	E	E	E	E	D	B	A	C	E	D	C	D	D	D	D	D	D
	John James Audubon Pkwy and I-990 NB Off	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C	N/A	B	B	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off	Roundabout	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	B	A	B	B	A

Table 36: BRT Build Alternative Weekend: MD Peak Hour Levels of Service

Peak	Intersection	Control	Northbound				Southbound				Eastbound				Westbound				Overall
			LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
			LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	N/A	A	A	A	B	A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	C	C	A
	John James Audubon Pkwy and Gordon R Yaeger	Signal	N/A	A	A	A	A	N/A	N/A	A	N/A	N/A	N/A	N/A	C	N/A	C	C	A
	John James Audubon Pkwy and Dodge Rd	Signal	D	C	C	C	C	B	A	B	C	C	A	B	C	C	C	C	B
	John James Audubon Pkwy and I-990 NB Off	Stop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	A	A	N/A	N/A	N/A	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off	Roundabout	A	A	N/A	A	N/A	A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	A

Table 37: BRT Build Alternative Weekday: AM Peak Hour Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
AM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	6	141	9	223	N/A	N/A	9	92
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	3	120	1	119	N/A	N/A	2	40
	John James Audubon Pkwy and Dodge Rd	Signal	16	151	37	291	20	228	48	329
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	19	215	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	31	4	133	N/A	N/A	2	80

Table 38: BRT Build Alternative Weekday: PM Peak Hour Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
PM Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	20	292	13	256	N/A	N/A	33	201
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	24	323	3	171	N/A	N/A	9	81
	John James Audubon Pkwy and Dodge Rd	Signal	292	1001	40	314	45	326	49	264
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	29	209	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	83	8	182	N/A	N/A	2	70

** Red Cells: Queue that is exceeding available storage or reaches upstream intersection*

Table 39: BRT Build Alternative Weekday: MD Peak Hour Queuing Results (ft)

Peak	Intersection	Control	Northbound		SouthBound		Eastbound		Westbound	
			average	max	average	max	average	max	average	max
MD Peak	John James Audubon Pkwy and Sylvan Pkwy	Signal	4	130	1	119	N/A	N/A	5	78
	John James Audubon Pkwy and Gordon R Yaeger Dr	Signal	5	155	1	86	N/A	N/A	4	59
	John James Audubon Pkwy and Dodge Rd	Signal	17	179	25	195	5	88	40	228
	John James Audubon Pkwy and I-990 NB Off Ramp	Stop	N/A	N/A	N/A	N/A	15	167	N/A	N/A
	John James Audubon Pkwy and I-990 SB Off Ramp	Roundabout	0	31	2	134	N/A	N/A	1	50

C.8 POLICY

As discussed in Section C.1, FHWA requires that any proposal involving a change in access to the interstate system must satisfy and document two policy points as outlined in the updated *Policy on Access to the Interstate System* (May 22, 2017). The two required policy points are:

- Operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility, and
- The proposed access connects to a public road only and will provide for all traffic movements.

This section documents Project impacts related to the two required policy points.

C.8.1 Policy Point 1: Operational and Safety Analysis

The proposed shift in the roundabout location, along with the introduction of the LRT Build Alternative and BRT Alternative, are not changing the operational functionality of the Interstate system. The proposed shift in the roundabout location will continue to allow for a full access movement on and off I-990 and John James Audubon Parkway.

Safety concerns related to the introduction of a roundabout as part of the roadway improvements required for the construction of the Muir Woods Student Housing development revolved around LRT tracks traversing through the middle of the roundabout and creating multiple points of conflicts between the LRT and general vehicles, as well as promoting queue spill back on the southbound I-990 off ramp.

By shifting the planned roundabout approximately 60 feet west, the tracks in the LRT Build Alternative would traverse across only the I-990 Southbound off ramp as depicted in Figure 11. By only introducing one conflict point on the off ramp, there would be a safety improvement by only creating one (1) at-grade crossing, which would include gates and signals to enhance the safety operations on the off ramp. It is not expected that southbound I-990 off ramp queues would negatively impact mainline I-990 operations. The worst-case scenario that accounted for increased train length and gate actuations has a maximum queue of 211 feet out of the available 1,100 feet storage capacity. Gates and signals would be installed as an operational and safety measure at all at-grade crossings.

There were no safety concerns related to access modification identified for the BRT Alternative.

C.8.2 Policy Point 2: Connection to a Public Road and Accommodation of all Interchange Movements

The proposed shift in the roundabout location does not change the existing connectivity from the I-990 John James Audubon Parkway, a public road.

The LRT Build Alternative's proposed changes accommodate all movements, and wayfinding signage will allow all drivers to clearly locate the ramp that leads them to and from the interstate and local roadways, in accordance with Policy Point 2. Using AutoTURN software and a Westbound-62 vehicle, an analysis was performed on the roundabout and the results indicated that the proposed modifications would create no issues.

The BRT Build Alternative effectively accommodates all interchange movements as demonstrated in Section C.6.4.

C.9 SIGNAGE PLAN

Federal guidance indicates that a conceptual plan of the type and location of the signs proposed to support each design alternative should be included in the AMR. A signage plan was developed to identify the proper signage required for the Project's proposed modifications to the planned roundabout at John James Audubon Parkway and the Southbound I-990 ramps. A signage plan for the BRT alternative is not required due to the BRT vehicle running in mixed operations north of Dodge Road. The LRT Signage Plan is illustrated in Figure 15.

Figure 15: Signage Plan for AMR